METHOD OF CONSTRUCTING STRIP FOUNDATIONS WITH LONGITUDINAL SOCKET

TECHNICAL FIELD

The present invention relates to the construction of foundations for industrial buildings or other similar buildings made of reinforced concrete and, in particular, to some pre-cast parts which become integral parts of the foundations.

The field of the invention is described in IPC Classification E 02 D 27/00 that generally relates to construction or foundations or more particularly group E 02 D 27/32.

BACKGROUND OF THE INVENTION

The present invention concerns constructing of special strip foundations with longitudinal socket-groove intended for large-span building structures with walls formed of upright-standing, load-bearing, cantilever panels supporting roof construction with or without intermediate floor constructions. In particular, the invention deals with a method and apparatus for constructing the below-ground building of said foundation.

In a traditional foundation constructing process the building foundation is formed of poured concrete which takes several days and many man-hours to be completed. The present invention streamlines greatly the traditional process reducing it to a one-day process which requires the crane, some specialized equipment and only a few workers for a greatly simplified task of preparing such foundation.

A traditional procedure, which is here briefly described in order to be compared with the present invention, begins with a trench dug into the ground, below the frost line to the required depth, around the perimeter of the building layout. In the next step a thin concrete cover is poured over the bottom of the trench, which takes at least one day to harden, to assure the flat and clean surface on which the welded mesh reinforcement of the strip footing and reinforcement of the longitudinal channel (or sockets) can be neatly placed. This being done, concrete ready-mix trucks deliver concrete to the building site and pour it to form the footing strip plate. The poured concrete is then given an additional day to harden before subsequent steps are undertaken. After concrete of strip footing plate has hardened, the reinforcement is to be completed, if not done before. In the next step, side forms

are installed to close the space of the two thin walls of the longitudinal socket channel. Finally, the socket channel is poured and next few days are needed for concrete to harden enough to be ready for receiving the panels.

Long and thin strips comprising longitudinal socket-groove cannot simply be carried out and accurately levelled without many labour-hours on building site such as; raising the huge amount of forms and levelling the same, placing reinforcement, concreting in two stages (footings and socket separately), and other activities, whereby weather-related problems may delay various steps of the constructing process.

The invented method, being a substitute for strip foundations traditionally cast in site, comprises several benefits comparing to the former method in accomplishing the task of constructing foundations. As there is always a need to streamline the process, the traditional procedure is by the present invention fastened and made a less labour-time consuming method because of using pre-cast concrete channels which are delivered to the building site, properly levelled by an adequate apparatus and poured at once. The quicker and easier way, offered by this invention, leads to the significant savings in labour and material making the entire process of constructing foundations less dependent on weather conditions.

DISCLOSURE OF THE INVENTION

As described above, quick and economic constructing of the strip foundations with longitudinal socket for the above mentioned type of structure is a general subject of this invention, although the same method and apparatus can be used to construct several different types of foundations. A typical load-bearing panel-assembled wall, mounted over strip foundations, serving the purpose of supporting this particular type of structure, is shown in Fig.1. Tall and slender wall-panels (1) are inserted into grooves of longitudinal sockets along the perimeter of the building, temporarily levelled and fixed by wedges, being fixed permanently in sequel by concrete poured into the gap between panels and thin walls of the groove, in the most common way.

This invention contemplates quick disposition of such long pre-cast reinforced concrete elements over the trench, which, hanging there temporarily and being held in predetermined position upon plurality of holding devices until all elements

(or by parts) are gathered and fine-levelled. Being arranged and firmly fixed, pre-cast elements are lastingly incorporated into poured in site strip-footing concrete, becoming a part of foundation, as shown in Fig.2.

In most common skeleton systems of the prior art, columns or frames bearing roof/floor constructions are supported by single footing foundations whereby forces and bending moments are transmitted to footings concentrated. In the present system whereby wall-panels, being arranged and loaded continuously along the strip foundation, vertical forces and bending moments are transmitted rather uniformly (distributed per unit length) over foundation. Compared to single foundations, the longitudinal strip foundations, due to reduced, essentially lower pressure at the concrete to ground contact surface can be carried-out at smaller depth whereby continuous distribution of forces and bending moments along the strip length enables application of thinner and wider dimensions of the footing strip.

Longitudinal socket-grooves ensuring fixed-end wall-panels to foundations connection, require the most accurate levelling of the common bottom, therefore it is advantageous to cast them in factory under stable circumstances such as; precise moulds, with presence of all necessary tools in one place and protected from bad weather conditions.

Use of pre-cast socket units delivered to the building site derives the problem of their accurate placement and levelling along the entire formed channel, composed of plurality of such units, before the concrete of the strip footing is poured. For that purpose, to complete the entire socket-channel as well as to assure neatly prepared, horizontally perfectly levelled continuous longitudinal channel, the holding devices are used, as illustrated in Fig. 7. Each pre-cast element is temporarily held by a couple of such devices as illustrated in Fig.4. Disposed in that way, plurality of recast elements assembled into a channel hang entirely over the trench bottom at a predetermined depth. Formed in that way, the hanging longitudinal socket, the bottoms of ends of adjacent elements can be positioned perfectly close, rendered compatible each to another, like being levelled by the same devices. Referring now to the Fig.4, the adaptable-length truss-girders of holding/levelling devices (5), bridge the trenches leaned against two supports (6), each being supplied by hydraulic lifting presses for up/down levelling. The lateral

inclination of the pre-cast element within the trench is avoided by hanging on two vertical rods of previously equalized length. The longitudinal inclination of the element is controlled by lifting presses at supports. Movement in direction of the axis of the element as well as lateral translational movement is enabled by rollers between the housing of the hydraulic pressures and the support pads. The finest horizontal movements in both horizontal directions are performed by sliding the housing of the support upon the support pad by hydraulic or similar means.

To obtain the proper connection between the pre-cast socket element and the strip poured on site, an adequate amount of reinforcement projecting from the bottom of the precast element must be provided, as shown in Fig.2. The precast element must be supplied with a certain amount of longitudinal reinforcement which assures small deflections due to lifting and transportation of the element, and due to standing over the trench. After precise levelling, such temporary hanged socket construction is poured with fresh concrete being in that way permanently fixed.

The main object of the invention is to provide foundation elements and techniques that greatly facilitate and accelerate the preparation of the building foundation of that type. The further object is achieved by features of the invention that permit the reduction in the manpower required to construct the foundation. It is comprehendible; if pre-cast elements are of 12 m approximate length, only few skilled workers are enough to construct several hundred meters length of finished foundations a day. The further benefit resides in the configuration of the pre-cast elements that can be combined in a variety of ways to create a wide range of foundation layouts by a set of pre-cast socket-channel components which can be provided and carried to the job site for quick assembling.

The invention is particularly suitable for construction of foundations for large span industrial and similar buildings, although the same components and techniques can be used for any other building comprising similar type of strip foundations.

DESCRIPTION OF DRAWINGS

Fig. 1 is a perspective view of the typical building supported by strip foundation with longitudinal socket groove as described in the present invention.

Fig. 2 is a cross-sectional view of finished foundation, showing the pre-cast element incorporated as integral part of strip footing.

Fig. 3 is a perspective view of the pre-cast element.

Fig. 4 is a perspective view of the foundation building site patch, illustrating the constructing process whereby the current pre-cast element is still hanging on the crane, supplied with holding/leveling devices, positioned to the trench before being levelled and a strip footing plate of foundation is poured.

Fig. 5 is a cross-sectional view, illustrating the constructing process stage whereby the pre-cast element temporarily hanging over the trench is supplied by horizontal bolt and two upright rods, before being re-hanged on the truss-girder.

Fig. 6 is a cross-sectional view, illustrating the constructing process stage whereby the pre-cast element temporarily hanging over the trench, is hanged on the truss-girder, being previously levelled, and waits for concreting of strip footing.

Fig. 7 is a perspective view of the holding/levelling device showing its constitutive parts.

DESCRIPTION OF THE PREFFERED EMBODIMENT

A typical load-bearing, wall-panel assembled structure mounted over strip foundation with longitudinal socket-groove, which is the subject of the present invention, is shown in Fig.1. Generally, such foundations, serving to receive and support this particular type of construction, comprise continuous longitudinal socket-grooves (3) along the entire strip footing (4) length. The vertical load bearing panels (1) supporting roof construction (also possible one or more intermediate floor constructions simultaneously) are in fact thin walled, widely-shaped, cantilever columns, closing the interior of a building, with their lower ends firmly fixed into a longitudinal foundation socket (3) with their upper ends free to lean the floor building elements against.

The pre-cast socket components (3), as shown in Fig. 2, replacing the traditionally cast in site longitudinal socket, which would be, if traditionally constructed, the most time-consuming part of constructing the foundations, are hereby delivered to the building site and promptly placed within prepared trenches, as illustrated in Figs. 4, 5 and 6. As the first step, the trench (8) of the predetermined width and depth according to the local soil conditions and site considerations is excavated below the frost line, around the perimeter of the building layout. Wide and shallow trenches are dug using an adequate excavator. The cross-sectional view of the

trench shape is shown in Fig. 2. In very coherent soils the preferred trench shape would be as denoted by dashed line. The smaller the soil coherence is, the more inclined trench lateral sides will be needed to prevent their sliding. In most cases, except in case of extremely incoherent soils, it is possible to obtain the firm earth sides near the trench bottom, whereto the strip-footings are poured so that no additional lateral forms are needed, as obvious in Fig. 2. Once the trench is dug, the foundation constructing process supported by proper equipment and skilled man-power proceeds in a quick and continuous way with small number of workers. As illustrated in Fig. 4, the crane (10) of a suitable capability moves along the trench side being continuously supplied with pre-cast socket units (3) delivered by transport vehicles (11) to the building site. Small group of about four workers disposed around the trench, following the crane, perform fixing holding/levelling devices to the pre-cast longitudinal socket units. Thus, still hanging on the crane slings, the pre-cast socket unit (3), furnished by two devices (5) each, becomes in that way capable of standing on the crane slings over the trench, where it is placed by the crane, with assistance of the same group. Thus being positioned, the crane slings are removed and the work proceeds by the crane taking the next element. The element (12) being already positioned into trench in described manner is subsequently adjusted and levelled by another group of workers by features of holding/levelling devices. In sequel, fresh truck-mix delivered concrete, following after levelling group, is poured into the trench below the hanging pre-cast socket elements (13) ,which, as illustrated in Fig. 4, form the footing of the strip foundations (4), joined firmly with the pre-cast element (3) through its protruding reinforcement (3.3) according to the Fig. 2. Moving onward, in above briefly described manner, along the trench, the procedure takes no more than fifteen minutes per twenty meters of finished foundation length (twenty meters is a length of the pre-cast unit). Thus organized, with skilled workers, under conditions of no interruptions or any disturbance, the procedure is performed even with approximate 1m/1minute speed what means 60 meter per hour.

The procedure is now described more precisely, containing necessary details, in the sequel. The holding/levelling device (5), shown in Fig. 7, comprises the main truss-girder (5.1) of a length which is longer than the trench-width, with extendable

ends (5.2), leaned against saddles (6.5) on the top of a pair of adjustable supports (6), positioned at each side of the trench as shown in Fig. 6. The light-weight trusses (5.1) easy-carried by two man are thereby used to bridge the trench over, holding the hanged pre-cast channel element (3) within the trench (8) above its bottom. Both supports (6) comprise hydraulic lifting presses (6.1) used for upward/downward movement placed within the steel housing (6.2) with enlarged basis (6.3), enabled to slide in two horizontal perpendicular directions. The extended basis (6.3) of the housing is leaned against the support pad (6.4) through set of rollers which movement is limited within the pad area (intentionally omitted here, considered as being of a secondary importance for the present invention).

The pre-cast socket element (3) hangs on two rectangular-shaped horizontal bolts (7) pulled through rectangular-shaped holes (3.2) in both of its thin walls. The rectangular-shaped holes (3.2) are used instead of round holes to prevent the bolt to rotate around its axis enabling in that way their upright attitude when rigged to the pre-cast element (3). The horizontal bolt (7) is hanged on two vertical rods (5.3) pulled vertically through holes of the main truss-girder (5.1) symmetrically about the midspan. The length of both rods (5.3) is adjustable for purpose of reaching the necessary height-position of the pre-cast element (3) over the bottom of the trench. The chosen length of both vertical rods (5.3) between the top of the truss-girder (5.1) and the desired level of the horizontal bolt (7) is fixed by two nuts (5.4). Being fixed in that way, at certain level, by nuts (5.4) on both devices simultaneously, the hanging pre-cast element hangs without lateral inclination and is ready to be levelled.

For purpose of lifting and handling, each pre-cast element comprises two pairs of holes through its thin walls positioned near quarters of its length, inner (3.1) and outer (3.2), as illustrated in Fig. 3. The inner pair of holes (3.1) is used to rig the pre-cast element to the crane slings. In the procedure, as illustrated in Fig. 4, being rigged by bolts at inner holes (3.1) the pre-cast element is hoisted from the truck by crane, which turning to the trench side keeps holding the hanged element (3) on slings over the trench until workers pull the bolt (7) through both end holes (5.5) of two vertical rods (5.3) and holes (3.2) in both elements' (3) walls. Both vertical rods (5.3) (standing now uprightly because of their prevented rotation by rectangular

shaped bolt, as said before), the crane gradually sinks the pre-cast socket element (3) into the ditch until the top of vertical rods gets inside of the reach of the workers' hands. The truss-girder (5.1) is then connected to both vertical rods (5.3) being fixed by nuts (5.4) and leaned against supports (6). Now hanging on two holding/levelling devices supported at each side of the trench, the pre-cast element (3) can be relieved from the crane slings. The board (15) positioned over the trench is used to assure access to the device.

The precise levelling is carried-out after pre-cast channel elements have been arranged temporarily, rather roughly. Before levelling, the accurate position of the currently placed element is obtained by moving the same at all four supports (6) simultaneously along and perpendicularly to its longitudinal axis. As said before, each support enables such a movement by sliding the housing-basis (6.3) over the support pad (6.4).

Levelling with task to achieve the zero longitudinal inclination of the pre-cast element (3) is performed at supports (6) by a pair of hydraulic presses (6.1). Acting simultaneously, the said pair of the presses (6.1) at each end of the element can increase or decrease its vertical level. If the precast element occurs to be inclined laterally, one single pressure at one side of the rod is activated to perform the slight correction. Thus arranged plurality of longitudinal socket elements hanging on the rods form accurately positioned longitudinal socket for entire foundation which can be again and again corrected until the desired accuracy is achieved. The said accuracy of the longitudinal socket is of a great importance in later stage of constructing walls, when panels are mounted and levelled in the upright position.

Finally, the complete longitudinal socket groove being perfectly levelled, hanging over the trench, is poured with fresh concrete to be incorporated to the ground by a third group of workers, which, following the levelling group finish the job of vibrating and screeding. The poured in site strip footing (4) fills the gap between the precast longitudinal socket (3), hanging firmly fixed at certain distance from the bottom of the trench (8). After the strip footing (4) concrete has hardened, hoisting/levelling devices (5) are removed.